X-847

INTRA-LABORATORY CORRESPONDENCE

OAK RIDGE NATIONAL LABORATORY

December 21, 1959

TO: W. H. Jordan

FROM: K. Z. Morgan

Now that we have survived three serious accidents during the past few weeks I would like to bring you up to date on the Health Physics version of accident number 1. This information is furnished by H. H. Abee and D. E. Arthur. Perhaps you will be particularly interested in Figures 1 and 2 which indicate the build-up and dilution of the radioactive contamination in the Clinch River at the time of this accident. You will note that the calculated and measured radioactivities in the Clinch River are below the calculated MPC value of the mixture of radionuclides at the time of the accident assuming there was no serious streaming in the river causing concentrations which are higher than those represented in graph 2 and assuming further that the section of the river from about mile 9 to mile 22 can be considered as being within the environment of the controlled area such that the MPC values for the population-at-large need not be applied. This report again suggests that a number of measures should be taken (some of which have already been accomplished) which would provide protection in case of similar accidents in the future. Important measures that should be considered are: (1) purchase a strip of land along the other side of the Clinch River facing the controlled area, (2) build a by-pass channel around White Oak Lake.

I am enclosing copies of this memorandum for all members of the Radioactive Operations Review Committee.

K. Z. Morgan

KZM:kd

Enclosures (7)

cc: A. M. Weinberg

K-947

INTRA-LABORATORY CORRESPONDENCE

OAK RIDGE NATIONAL LABORATORY

December 14, 1959

7 Copies distributed for RORC

To: J. C. Hart - A. B. Wardem

Re: High Level Liquid Waste Leak, November 1, 1959

Higher than normal levels of radioactivity were detected entering the diversion box at the equalization basin of the ORNL waste treatment system by Operations Division personnel on Wednesday, October 28, 1959. The level of activity fluctuated up and down for several days. On Saturday evening the fluctuation in activity reached progressively higher levels and persisted at these levels.

Health Physics personnel on shift had been asked to sample White Oak Lake each shift during this period because of the fluctuating activity levels. If analysis of the samples indicated a gross beta count of the order of 100 c/m/ml at 10% geometry, they were instructed to close White Oak Dam and hold the effluent in White Oak Lake. The 7:00 a.m. sample from White Oak Dam on Sunday, November 1, 1959, counted 94 c/m/ml gross beta and the dam was closed at 8:45 a.m.

Gamma spectrometry analysis of a sample of the effluent leaving the settling basin area indicated the activity to be predominantly Ru^{106} and Ce^{144}. Samples were taken each shift from White Oak Lake even though the dam was closed to observe the rise in gross beta activity as water was impounded. The results of these samples are given in Table I.

TABLE I

Date	Time	Gross β Activity c/m/ml at ~ 10% Geometry
		94
11-1-59	7:00 a.m.	115
11-1-59	8:00 p.m.	186
11-2-59	1:45 a.m.	239
11-2-59	5:00 a.m.	225
11-2-59	8:30 a.m.	250
11-2-59	7:30 p.m.	325
11-2-59	10:30 p.m.	269
11-3-59	2:30 a.m.	169
11-3-59	6:00 a.m.	

The 6:30 a.m. sample on November 2 was analyzed radiochemically for Sr^{90} and for alpha activity by alpha range analysis. The analysis results indicated that the water contained less than 200 d/m/ml Sr^{90} and gross alpha activity of approximately 15 d/m/ml. The alpha range analysis indicated the alpha activity was approximately 50% americium, 30% curium, 20% plutonium, and 10% neptunium.

In order to validate the 8:30 a.m. sample, a number of samples were taken from various parts of White Oak Lake and subjected to analysis. The average gross beta activity for the samples was [illegible] d/m/ml. The Sr-90 content averaged 15.8 d/m/ml. The gross alpha activity averaged approximately 16 d/m/ml and indicated greater than 95% of the activity to be due to a 6.11 mev component, probably curium.

A rough approximation of the MPC_v value for the population in the neighborhood of an atomic installation based on the analysis results gave a value of 7×10^{-6} μc/cc. The gross beta concentration in the lake was 2.5×10^{-3} μc/cc. Under these conditions the lake could be drained successfully if the outflow could be controlled in such a way that a dilution factor of at least 500 could be obtained. The predicted flow in the Clinch River for the first week following the incident was in excess of 5000 cfs; thus White Oak Lake water could be released at a rate of 10 cfs without exceeding MPC_v.

Release of water by raising the lower gate at White Oak Lake under the conditions prevailing would mean that the opening would act as a submerged orfice and the flow governed by the formula $Q = .62 A \sqrt{2 gh}$. The flow necessarily would have to be calculated since measurement under these conditions would be very difficult if not impossible.

The lower gate was opened .1 feet at 10:20 a.m. on November 3 and the outflow calculated to be 4.2 cfs. After 2. 5 hours, it was observed that this gate opening stemmed the rise but did not lower the liquid level in the lake. At 12:55 a.m. the gate was raised an additional .1 foot and allowed to remain at this setting until 8:40 a.m. on November 5. Flow calculation gave average flows ranging from 8.1 cfs on November 3 to 7.1 cfs on November 5, and the water level in the lake dropped approximately 1 foot. At 8:40 a.m. on November 5, the gate was again raised an additional .1 foot, now making an opening of .3 feet. The calculated average flow with this setting for the remainder of the day was 9 cfs. The flow decreased gradually to 4.3 cfs by 8:00 a.m. on November 6, 1959, at which time White Oak Lake was completely drained.

When the gate at White Oak Lake was opened, continuous sampling of the effluent was begun with the continuous sampler normally used for this purpose. The gross β activity in the daily composite samples collected during the draining was as follows:

Date	Gross β Activity d/m/ml at 10% geometry
11-3-59 - 11-4-59	398
11-4-59 - 11-5-59	136
11-5-59 - 11-6-59	55

An estimate of the gross beta activity released during the draining based on the calculated flows and the measured concentration in the daily samples was 55.1 curies.

When the incident occurred, the Health Physics group of the Oak Ridge Gaseous Diffusion Plant (K-25) were notified of the problem. Information regarding the isotopic content of the spill and probable concentration in the Clinch River upon release of the activity was verbally given to the director

of the plant. [illegible] may alert them to the frequency and number of samples taken at their sampling stations and observe the effect of the release upon their water supply.

A discussion by telephone with a member of TVA the day after the incident revealed that under the conditions of flow existing and predicted for the Clinch River, the time of travel of activity when released from White Oak Creek to K-25 would be of the order of 10 - 14 hours.

On Wednesday, November 4, members of the Area Monitoring Section took water samples and made gamma measurements in the Clinch River from the mouth of the Clinch to Clinch River Mile 21.5 above the mouth of White Oak Creek. The gamma measurements were made by suspending the river survey instrument (Ecumidar) at a depth of five feet below the water surface at midstream at approximately two mile intervals going upstream. At alternate locations additional measurements were made at greater depths (10 - 25 ft.), depending upon the depth of the river. The data were corrected for cosmic background and is plotted in Figure 1. The data seems to indicate some thermal stratification or dusk under of the activity at greater distance downstream.

Water samples of approximately one liter taken from the surface of the stream were evaporated to dryness and counted for gross beta activity in the low level beta coincidence counter at the Low Level Analytical Chemistry Laboratory. The results from these samples are plotted in Figure 2. The maximum concentration was observed just below the mouth of White Oak Creek, the concentration being 3.7×10^{-9} μc/cc. The concentration in the river at K-25 water intake was found to be approximately 1.5×10^{-9} μc/cc. Thus, it appears evident that the concentrations in the river following the release of the wastes were in fact less than the calculated MPC, values determined from the analysis of the waste samples.

Attached is a report by D. E. Arthur giving background information related to the leak.

H. M. Abee

HMA:dc
Attachments
cc: S. I. Auerbach
AEP File
HMA File

FIGURE 1

Data Collected Nov. 4, 1959

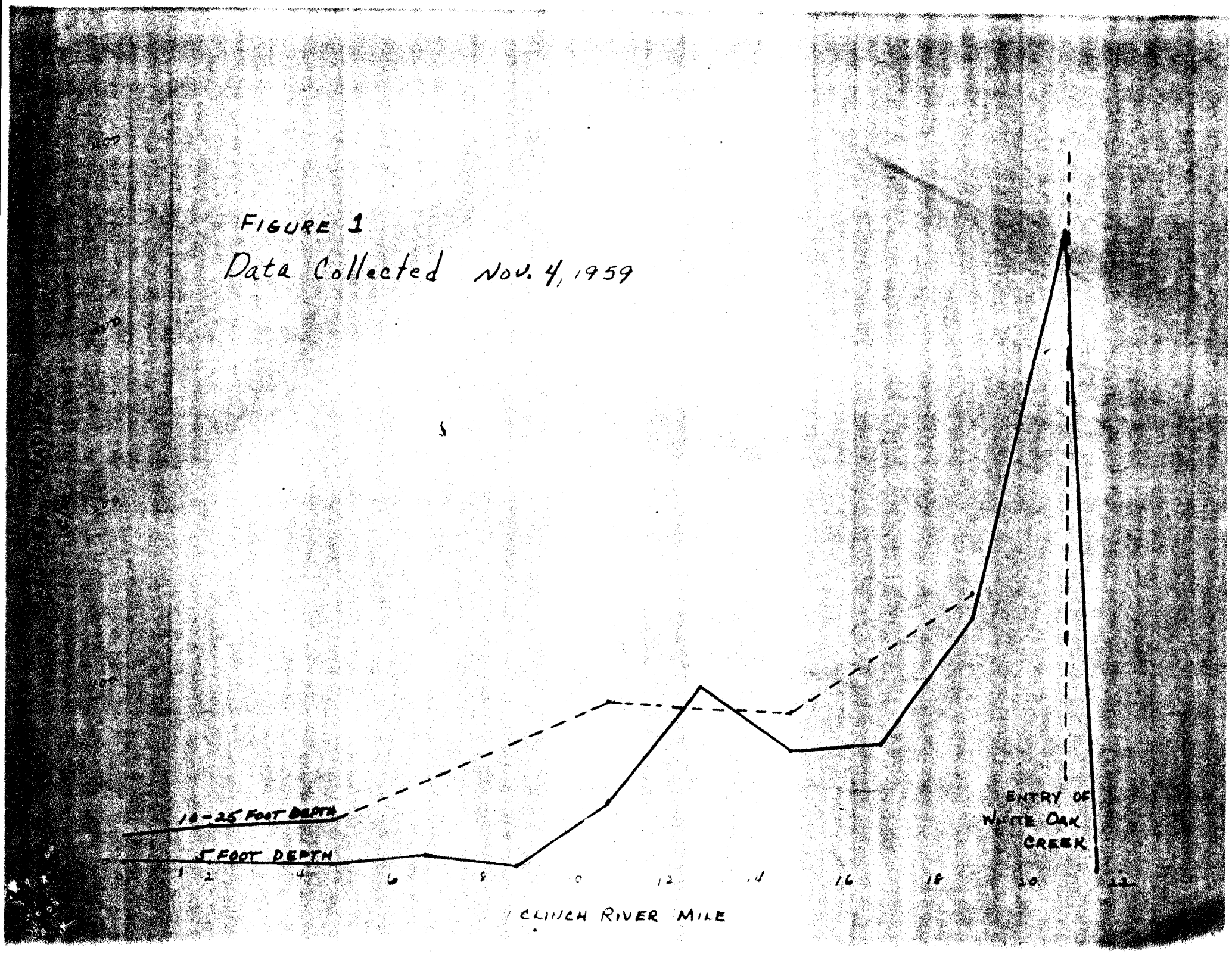
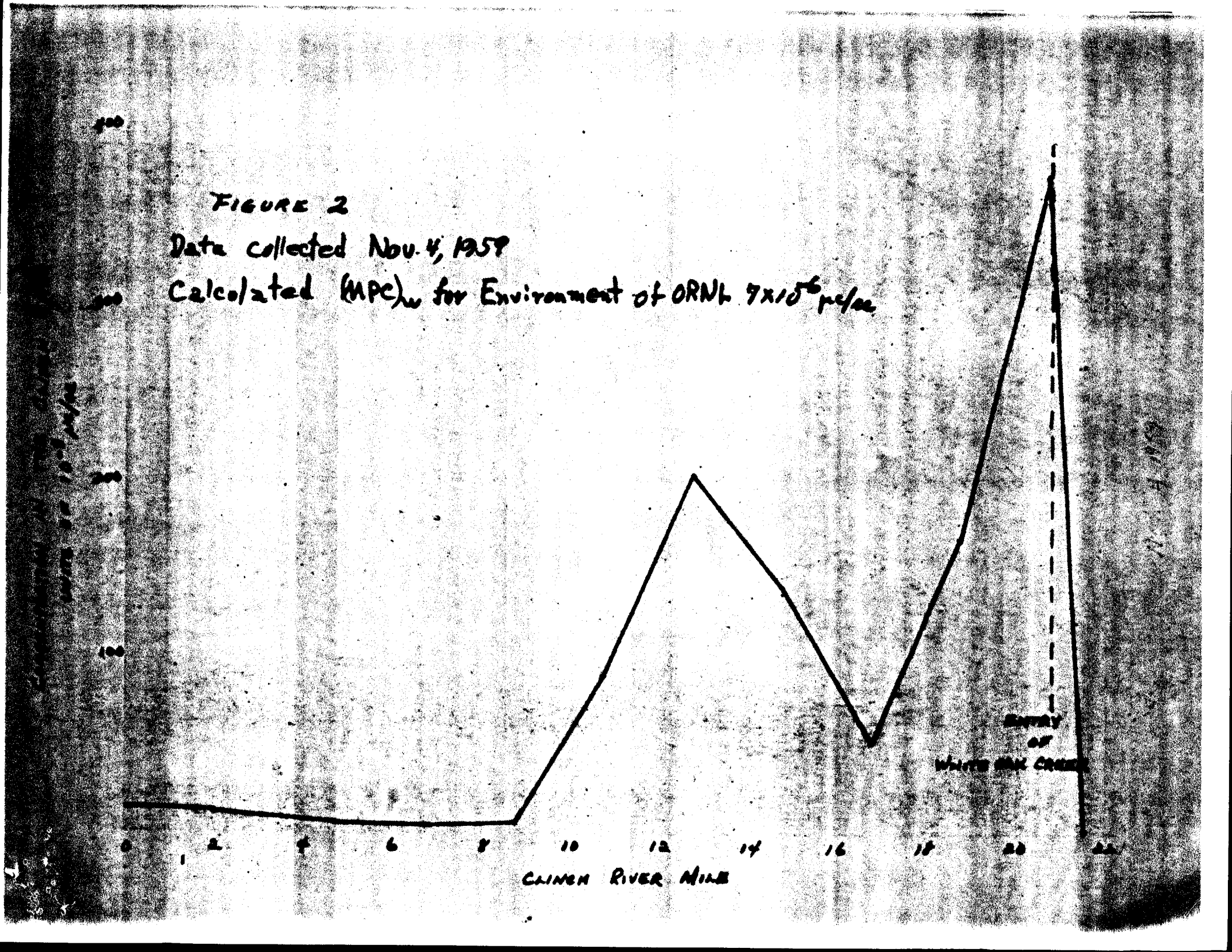


FIGURE 2

Data collected Nov. 4, 1957

Calculated $(MPC)_w$ for Environment of ORNL 7×10^{-6} μc/ml



INTRA-LABORATORY CORRESPONDENCE

OAK RIDGE NATIONAL LABORATORY

December 14, 1950

To: J. C. Hart • A. D. Warden

Re: Background Information Related to the Leak Which Occurred 10-31-50

This particular run was the processing of eight MTR plutonium fuel assemblies. The desired products were rare earths, curium^{242}, and Americium^{242}.

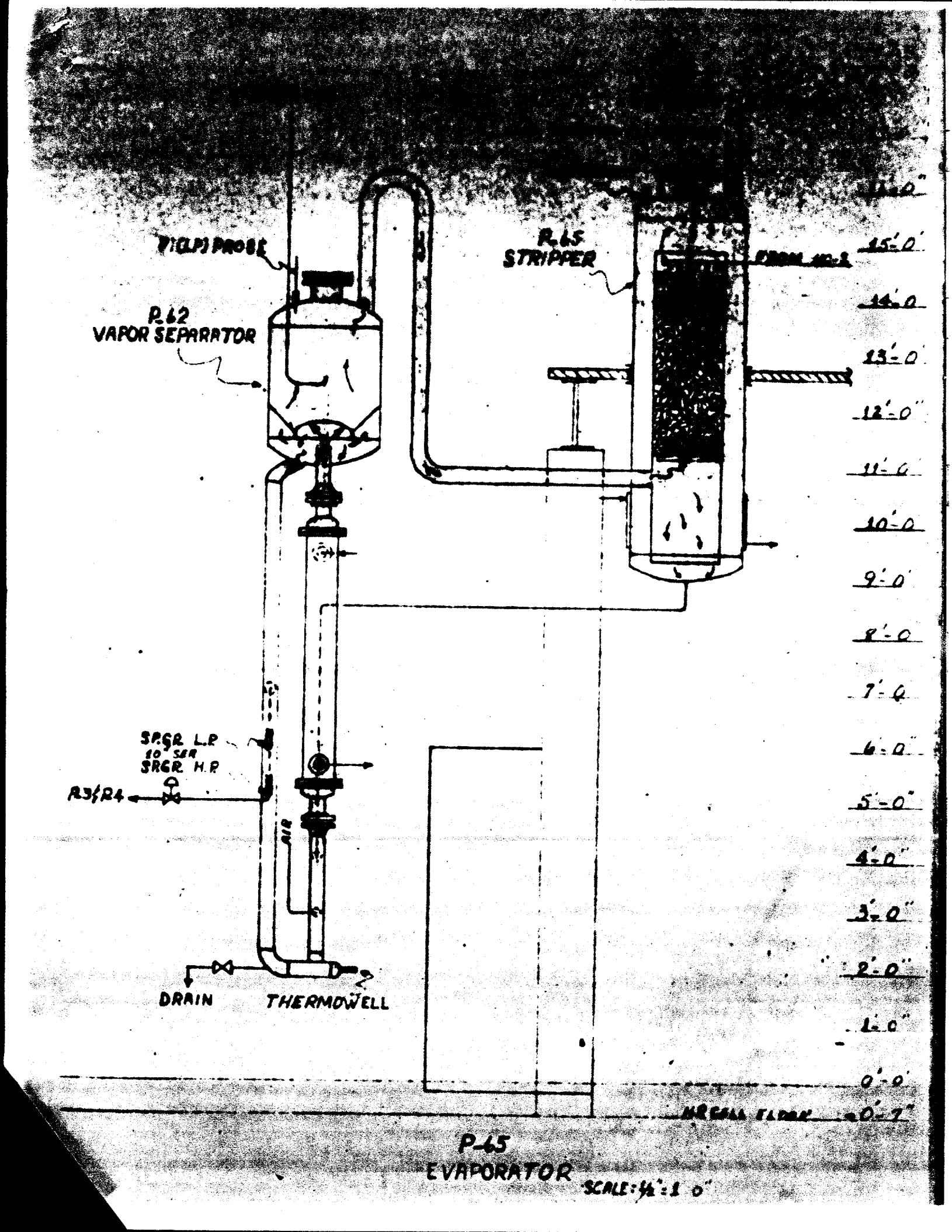
These fuel elements were processed using the plutonium flowsheet. Four hundred grams of Pu were recovered instead of the expected 300 gm. The plutonium was transferred to Bldg. 3505 for further purification. The waste which contained the fission products, rare earths, curium^{242}, and Americium^{242} was then recycled using a flowsheet to separate the fission products from the rare earths, Cm^{242} and Am^{242}. This had been done, leaving the rare earths, Cm^{242} and Am^{242}, as products in the inter cycle evaporator (F-62) to be concentrated. This was then to be transferred to X. X. Lease. Bldg. 3508, for further separation.

The evaporation process was approximately 50% completed when the high activity was discovered in the settling basin. The evaporation under normal conditions is accomplished by maintaining continual steam pressure on the heat exchange. Should a leak occur under these conditions, the leak would be into the product rather than into the condensate. During this special program small amounts of the product were transferred into the evaporator and concentrated for 4 hours and then transferred out. It is thought that when the steam was shut off after the four hours operation, a negative pressure developed in the steam side of the heat exchange allowing some of the product to be transferred into the condensate.

NOTE: A detailed report of events leading up to and following the leak discovery is being prepared by J. R. Parrott.

D. E. Arthur

DEA:de
Attachment
cc: S. I. Auerbach
E. H. Klein
MEP File



P-65
EVAPORATOR
SCALE: ½" = 1'-0"